Institution:
Cardiff University

Unit of Assessment:
UoA5_Casestudy2

Title of case study:
Delivering UK policy for river conservation and management

1. Summary of the impact

New approaches to analysing and modelling water systems, developed at Cardiff, have driven national policy changes to improve the proportion of fully functioning water ecosystems in the UK. UK Government, Welsh Government and a range of NGOs have adopted these new approaches, which replace traditional descriptive methods with experimental, analytical and modeling techniques for understanding water ecosystems.

These approaches have been used to develop the water-related component of the National Ecosystem Assessment. This document has directly impacted on UK river management policy, forming the basis of two Defra White papers, 'Natural Choice' and 'Water for Life', underpinning Welsh Government's Natural Environment Framework and informing the work of a range of NGOs.

2. Underpinning research

Cardiff research background

Since 1993, Cardiff's Professor Ormerod (1993-present, promoted to Professor 2001) has pioneered a distinct research paradigm in which stratified surveys, experiments and models are applied to river catchments to investigate large-scale factors affecting river organisms and ecological functions. (Catchment: the area contributing surface or sub-surface water to any given river thereby determining its water quality, water quantity and ecological character). Previously, river investigations were descriptive, characterised by uncertainty and unable to support evidence-based management at sufficiently realistic scales.

In 1993, Ormerod and his team of researchers investigated claims based on descriptive assessments that acid rain was causing widespread changes in the chemistry and ecology of upland European rivers. Using UK-wide surveys stratified by land-use and geology, they revealed that ecological problems were greatest where base-poor rivers drained plantation forest[3.1]. The success of this method led to publications from unique catchment-scale experiments in which forest cover and stream chemistry were manipulated in the Llyn Brianne Stream Observatory (a network of 14 intensively monitored streams in central Wales controlled solely by Cardiff University from 1993 onwards) to test hypotheses about the mechanisms and effects of acid rain in the UK[3.2].

World's first upland river ecosystem climate change data

Throughout the REF period, Ormerod's methods were used to carry out long-term observations from the Llyn Brianne Stream Observatory to deliver the world's first data revealing climate-change effects on upland river ecosystems. Findings include:

- Assessments of the ecological effects of climate change in streams (2007) [3.3]
- How sensitivity to climate change varies across different environments (2009)[3.4]
- How modifications to riparian land use (at the interface between river and land) can offset the worst effects (2009)[3.4]
- The processes leading to local extinction in sensitive stream organisms (2010)[3.2,3.4]

Assessing river management options and linking biodiversity gains

Using his analytical techniques, Ormerod reviewed recent trends in British river ecosystems to identify the factors affecting river ecosystem services at catchment scales, also defining and assessing future management options[3.5]. (Ecosystem services from rivers include drinking water, flood-defence, pollutant detoxification and disposal, fisheries, recreation etc.). This research revealed how long-term river restoration and tighter regulation for ecosystem services such as drinking water, sanitation and the control of diffuse pollutants is closely linked to biodiversity gain[3.6].

The National Ecosystem Assessment (NEA)

The insight gained into the resistance and resilience of upland streams and their catchments led to the UK Secretary of State for the Environment asking Ormerod to join the expert panel of the National Ecosystem Assessment (NEA) in 2009 to lead the freshwater component. Co-chaired by Prof Bob Watson (Chief Scientific Advisor to Defra) and Prof Steve Albon (James Hutton Institute), the NEA aimed to ensure the sustainability of ecosystem services in support of the UK's international obligations.

Beyond the NEA, Ormerod also influences a number of other environmental bodies through his programme of work. Currently he is Trustee and Chair of the Royal Society for the Protection of Birds (RSPB) Council, Deputy Chair of Welsh Water's Environment Advisory Panel and Chair of the Natural Environment Research Council (NERC) Centre for Ecology and Hydrology Science Development Group. His status in the field was recognised in 2011 when he received the Marsh Award for Freshwater and Marine Conservation from the Zoological Society of London. In 2012, Ormerod's group received one of the largest ever NERC grants (£3.1 million NE/J014818/1) to continue their work on the role of biodiversity in river ecosystem services at catchment scales. In 2013, Prof. Ormerod's group shared in a EU consortium award of €9 million for work on multiple stressors on river ecosystem services, and he will lead a core work package on catchments.

3. References to the research (indicative maximum of six references)

3.1 **Ormerod, S. J.** Rundle, S. D., Lloyd, E. C., Douglas, A. A. (1993). The influence of riparian management on the habitat structure and macroinvertebrate communities of upland streams draining plantation forests. Journal of Applied Ecology, 30, 13-24 http://www.ephemeroptera-galactica.com/pubs/pub_o/pubormerods1993p13.pdf

3.2 **Ormerod. S. J., Durance, I.** (2009) Restoration and recovery from acidification in upland Welsh streams over 25 years. Journal of Applied Ecology, 46, 164-174 http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2008.01587.x/full

3.3 **Durance, I., Ormerod, S. J.** (2007) Climate change effects on upland stream invertebrates over a 25 year period. Global Change Biology, 13, 942-957 http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2486.2007.01340.x/full

3.4 **Ormerod, S. J.** (2009) Climate change, river conservation and the adaptation challenge. Aquatic Conservation: Marine and Freshwater Ecosystems, 19, 609-613 http://dx.doi.org/10.1002/aqc.1062

3.5 Maltby, E., **Ormerod, S.J.** (2011) Freshwaters - Openwaters, Wetlands and Floodplains. In: The UK National Ecosystem Assessment Technical Report, pp. 295-360. UNEP-WCMC, Cambridge. http://nora.nerc.ac.uk/16133/1/Ch9Freshwaters.pdf

3.6 **Vaughan, I. & Ormerod, S. J.** (2012) Large-scale, long-term trends in British river macroinvertebrates. Global Change Biology, 18, 2184-2194 http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2486.2012.02662.x/full

4. Details of the impact

Over the last 20 years, Prof. Ormerod's approach to improving water management practices, in particular catchment management and river conservation has influenced the policy-making and advocacy activities of a range of government bodies and major NGOs. These bodies include Defra, the Environment Agency, Countryside Council for Wales, RSPB, Rivers Trusts and Wildlife Trusts. Specifically, Ormerod wrote two key documents[5.1,5.2] which facilitated the implementation of the Habitats and Species Directive (92/43/EEC) and the Water Framework Directive (EU 2000/60/EC) in catchment scale risk assessments for acidification and climate change.

Influencing policy and practice: National Ecosystem Assessment

A key driver to changing the policy agenda in the UK has been the National Ecosystem Assessment (NEA), the first benefit analysis of the UK's natural environment, which was funded by Defra, all of the devolved administrations as well as the Natural Environment Research Council and the Economic and Social Research Council. Between 2009-11 Prof. Ormerod applied his research on river catchment and conservation management directly to this policy framework as co-

leader of the freshwater components of the NEA[3.5].

The NEA included specific conclusions based on Prof. Ormerod's research, including:

- Freshwater ecosystems were critical to human wellbeing, but undervalued
- Ecosystem management has emphasised resource production (e.g. food, forests) to the detriment of less tangible services downstream (e.g. polluted water)
- Freshwater ecosystems and their catchments should be restored and managed positively to maximise ecosystem service benefits

Earl Selborne stated in the House of Lords that the NEA could prove to be "a massively helpful tool to help decision-makers in government, business and society put in place long-term measures to protect and enhance our ecosystem services, including our biodiversity"[5.3]

Influencing policy and practice: a tool for government

The catchment management methodologies established by Prof. Ormerod have since been embedded nationally as the key tool to maintain the ecosystem services provided by the fresh-water environment through the policy framework outlined in Defra white papers on the Environment and Water, which adopt the methodology.[5.4,5.5]

The NEA forms the central basis for Defra's 'Natural Choice', the first White Paper on the natural environment in 20 years. This document draws heavily on what it calls the "groundbreaking studies" such as those contained within the National Ecosystem Assessment[5.4] (e.g. p15 section 2.1).

The catchment approach has also had a direct Influence on the Defra white paper on water, "Water for Life", where the NEA is placed "at the heart of our drive to improve environmental water quality" [5.5] (e.g. p30 section 3.5) and in which the UK government commits to the catchment approach for managing water quality, abstraction and wider environmental issues[5.5](e.g. p28, 29, 30-35).

It also forms a central plank of Defra's biodiversity strategy (2011-20) aimed at restoring England's terrestrial and freshwater biodiversity, with Lord Henley, speaking on behalf of Government, attesting that the "strategy builds on the evidence provided by the ground-breaking national ecosystem assessment" [5.6](Lords Hansard 730 c26-7WS, 07/09/2011).

The NEA's ecosystem services concept has become a key pillar in the development of Wales' Natural Environment Framework and its single body for the environment[5.7]. These Welsh Government policy initiatives use the ecosystem services and catchment paradigms specifically to link land and water management together through unified environmental bodies with responsibility for both.

Subsequent initiatives empowered partnership between statutory agencies and river-based NGOs (eg Rivers Trust) as key agents in implementing the catchment management methodology, as part of concerted action to fulfil the UK's obligations under the Water Framework Directive[5.8]. Arlin Rickard, CEO of the Rivers Trusts, stated that Prof. Ormerod's "research and the practical and achievable methodologies which he has produced have benefited a range of organisations, including UK Government, which adopted Professor Ormerod's catchment management approach as a central plank of the NEA…[and his] research work on acidification, climate change and land use change are used directly by the Rivers Trust Movement in practice and in informing our own advocacy and policy with governments in Westminster and Cardiff."[5.9]

In 2012, the impact of the research undertaken by Prof. Ormerod was cemented further on his election as chair of RSPB, Europe's largest wildlife NGO. RSPB CEO Mike Clarke wrote that "the work of the Cardiff Bioscience School on river conservation and catchment science has impacted directly on a number of policy areas the most advanced of which is the management of the water cycle (see Natural Environment and Water White Papers)" and that "the river catchment studies developed by Prof Ormerod and colleagues have been had pivotal effects on the development of ecological, economic and policy decision-making tools in this sector." [5.10]

By improving river management, Prof. Ormerod's research underpins positive management for river ecosystems and the public benefits they provide[3.5,3.6]. Improved catchment management, as

engendered by Prof. Ormerod's analysis for the NEA has been enacted through a number of UK government policies[5.4,5.5,5.8], in order to reduce the expenditure needed to sustain recreational fisheries, water treatment and river biodiversity.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 Ormerod, S. J., Durance, I. (2008) Evaluating climatic effects on aquatic invertebrates in southern English rivers. Environment Agency Report SC070046 A report describing methodologies for meeting obligations related to the Habitats and Species directive and WFD on behalf of the EA. https://publications.environment-agency.gov.uk/skeleton/publications/ViewPublication.aspx?id=baeacf62-8484-4ccd-b5fa-a508b621421b

5.2 Ormerod, S. J. et al. (2012) Landscape Connectivity of Freshwater Ecosystems: Strategic Review and Recommendations. Countryside Council for Wales (CCW) Contract Science Report No: 932, 117pp, CCW, Bangor. A report describing methodologies for meeting obligations related to the Habitats and Species directive and Water Framework Directive on behalf of CCW (Document available on request)

5.3 Lords Hansard proceeding, verifying the value of NEA to the development of UK Environmental policy and decision making 728 c1109-12, 20/06/2011 (Document available on request)

5.4 HM Government (2011) The Natural Choice: Securing the Value of Nature. The Stationery Office. Government white paper referencing the UKNEA. http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf

5.5 HM Government (2011) Water for Life. The Stationery Office. Government white paper referencing the UKNEA. http://www.official-documents.gov.uk/document/cm82/8230/8230.pdf

5.6 Lords Hansard proceedings, corroboration that the NEA was the basis for DEFRA's biodiversity Strategy 2009-11, 1730 c26-7WS, 07/09/2011 (Document available on request)

5.7 Welsh Government (2012) Sustaining a Living Wales. A Green Paper on a New Approach to Natural Resource Management in Wales. WG13943. Contribution of NEA to policy development (e.g. page 4, Para 2; Page 9). http://wales.gov.uk/docs/desh/consultation/120209nefgreenpaperen.pdf

5.8 Defra (2013) Catchment Based Approach: Improving the quality of our water environment (page 9), describing Defra's strategy for improving the water environment utilising the Catchment approach, as detailed in the UKNEA https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204231/pb13934-water-environment-catchment-based-approach.pdf

5.9 Chief Executive, The Rivers Trust. Verifying Ormerod's contribution to upland river conservation. (Statement available on request)

5.10 Chief Executive, RSPB. Verifying Ormerod's contribution to the introduction of catchment management and ecosystem services methodologies in national policy. (Statement available on request)